

WHAT IS CLAIMED IS:

1. A reflection-transmission double type liquid-crystal display device comprising:

a transmission type liquid-crystal display panel  
5 including a liquid-crystal cell;

at least one illuminator disposed on at least one of side surfaces of said liquid-crystal display panel and capable of being switched on/off;

an optical path changing sheet which has a refractive index exhibiting a refractive index difference of not higher than 0.15 from a refractive index of a nearest liquid-crystal cell substrate, and which is bonded onto a back side (opposite to a visual side) of said liquid-crystal display panel through an adhesive layer having a refractive index exhibiting a  
10 refractive index difference of not higher than 0.20 from the refractive index of said nearest liquid-crystal cell substrate;  
15 and

a reflection layer disposed on a back side of said optical path changing sheet,

20 wherein said optical path changing sheet has optical path changing slopes and flat surfaces, each of said optical path changing slopes facing said illuminator at an inclination angle in a range of from 30 to 48 degrees with respect to a plane of said optical path changing sheet and being provided for  
25 reflecting incident light from said illuminator toward said

visual side of said liquid-crystal display panel, each of said flat surfaces being inclined at an inclination angle of not larger than 10 degrees with respect to said sheet plane so that a projected area of said flat surfaces on said sheet plane is not smaller than 10 times as large as a projected area of said optical path changing slopes on said sheet plane.

2. A reflection-transmission double type liquid-crystal display device according to claim 1, wherein said liquid-crystal display panel further includes a polarizer disposed on one or each of side surfaces of said liquid-crystal cell.

3. A reflection-transmission double type liquid-crystal display device according to claim 2, wherein said liquid-crystal display panel further includes at least one phase retarder disposed between said liquid-crystal cell and said polarizer.

4. A reflection-transmission double type liquid-crystal display device according to claim 1, wherein each of cell substrates for said liquid-crystal cell is made of an optically isotropic material.

5. A reflection-transmission double type

liquid-crystal display device according to claim 1, wherein said optical path changing sheet is provided as an optical path changing sheet including optical path changing slopes forming ridgelines inclined at an angle of not larger than 30 degrees with respect to said side surface on which said illuminator is disposed; and said optical path changing sheet is disposed so that said optical-path-changing-slope-forming surface of said optical path changing sheet is located on said back side (opposite to the visual side).

6. A reflection-transmission double type

liquid-crystal display device according to claim 1, wherein a refractive index difference between said adhesive layer and said nearest liquid-crystal cell substrate and between said optical path changing sheet and said nearest liquid-crystal cell substrate is not larger than 0.10.

7. A reflection-transmission double type

liquid-crystal display device according to claim 1, wherein said optical path changing sheet includes a repetitive structure of prismatic structures having optical path changing slopes inclined at an inclination angle of from 35 to 46 degrees with respect to said sheet plane.

8. A reflection-transmission double type liquid-crystal display device according to claim 7, wherein each of said prismatic structures of said optical path changing sheet is constituted by a concave portion substantially shaped like a triangle in section.

9. A reflection-transmission double type liquid-crystal display device according to claim 7, wherein said prism-like concave portions are constituted by continuous grooves extended from one end of said optical path changing sheet to the other end thereof in a ridgeline direction parallel to or inclined to said side surface of said liquid-crystal display panel on which said illuminator is disposed.

10. A reflection-transmission double type liquid-crystal display device according to claim 7, wherein said prism-like concave portions are constituted by discontinuous grooves each of which has a length of not smaller than 5 times as large as a depth of said groove and in which a longitudinal direction of said groove is substantially parallel to said side surface of said liquid-crystal display panel on which said illuminator is disposed.

11. A reflection-transmission double type liquid-crystal display device according to claim 1, wherein

light reflected by said reflection layer is diffused so as to be made incident on said liquid-crystal cell.

12. A reflection-transmission double type liquid-crystal display device according to claim 11, wherein at least said reflection layer, said optical path changing sheet or said adhesive layer for bonding said reflection layer to said liquid-crystal display panel exhibits light diffusing characteristic.

13. A reflection-transmission double type liquid-crystal display device according to claim 12, wherein said light diffusion type reflection layer has a rough surface of fine prismatic structures, and a high-reflectance metal thin film disposed on said rough surface of fine prismatic structures, or wherein a light diffusing layer is disposed on an optical-path-changing-sheet-side surface of said high-reflectance metal thin film.

14. A reflection-transmission double type liquid-crystal display device according to claim 12, wherein a reflection layer of a high-reflectance metal thin film is provided onto an optical-path-changing-slope-forming surface of an optical path changing sheet, the optical-path-changing-slope-forming

surface being roughened, or onto an

optical-path-changing-slope-forming surface of a light

diffusion type optical path changing sheet; or

6 wherein a reflection layer of a high-reflectance metal

5 thin film is provided onto an

optical-path-changing-slope-forming surface of an optical path

changing sheet, said optical path changing sheet being bonded

through a light diffusion type adhesive layer.

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